Growth and mortality rates of small corals in St. John, US Virgin Islands, 1996-2018

Website: https://www.bco-dmo.org/dataset/827764
Data Type: Other Field Results
Version: 1
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Project
» RUI-LTREB Renewal: Three decades of coral reef community dynamics in St. John, USVI: 2014-2019 (RUI-LTREB)

Contributors	Affiliation	Role
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Abstract
Growth and mortality rates of small corals in St. John, US Virgin Islands, 1996-2018. These data are the raw data from which growth rates, mortality rates, and Leslie Matrices were prepared.

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Coverage

Spatial Extent: **N**:18.31714 **E**:-64.7208 **S**:18.30702 **W**:-64.73152
Temporal Extent: 1996 - 2018

Methods & Sampling

From publication Limnology and Oceanography

Tagged corals

Starting in 1996, corals were tagged for the assessment of growth and survival. Five sites were selected at ~ 5-m depth between Cabritte Horn and White Point on the south shore of St. John, and a sixth site was added at 9-m depth at Cabritte Horn in 1998. Thereafter, tagging and surveys proceeded at all sites annually to 2018. Sites were haphazardly selected to be representative of shallow fringing reefs, and are characterized by igneous boulders and cliffs. Sampling targeted small corals (≤ 4-cm diameter) as they were encountered while working along permanently marked transects (15–30 m long) placed at the isobath.

Tagging and measuring took place in July and August of each year, and the effort allocated to this task varied among years depending on logistics. Corals were individually marked with numbered aluminum tags that were attached to non-living substrata using epoxy. Tags were placed 1–2 cm from each coral to facilitate identification the following year. When corals were tagged, their sizes were measured using calipers (± 1 mm) to record their major and minor diameters in planar view, and they were identified to the lowest taxonomic resolution possible (at least genus, and often species). Tagged corals ranged in size between the smallest that could be located (~ 2-mm diameter) and 4-cm diameter, and sampling each year continued until ~ 100–300 colonies were tagged in combination at the 5–6 sites.

Following deployment, the tags fouled with algal turf and crustose algae, and the following year they were located using metal detectors. When tags were found, they were cleaned to reveal the number, and the marked coral was located, assessed for condition (alive or dead), and if alive, measured. Corals were scored as dead if their tag was found and the coral was missing, or the coral was dead in place. Tags were removed from the substratum if the coral they marked had died, or if the coral had grown larger than the target range of the study (4-cm diameter). Following surveys, new tags were added to mark additional corals to maintain sample sizes among years. As the assemblage of small corals changed among years through taxonomic variation in mortality, recruitment, and growth (that affected graduation from this size range), the taxonomic composition of corals surveyed annually also varied. Tagged corals that remained ≤ 4-cm diameter at the end of each census were retained in the study and measured the following year if the tag was relocated.

Analysis

Coral census data were used to prepare 4 × 4 Leslie Matrices, for all corals (i.e., pooled among taxa). Genus- and species- level analyses of the survey data were not feasible given the small sample sizes when the results were subdivided by taxon. Population matrices were explored for the most common coral tagged each year (Porites spp.) in order to gain insight into the possibility of biased results attributed to pooling among taxa, although the results for this genus are not presented in detail. Variation over time in the taxonomic composition of the tagged corals was explored using 2-dimensional ordination prepared using non-metric multidimensional scaling (NMDS) based on square-root transformed, relative abundances, and Bray-Curtis dissimilarities.

Matrices were composed of four size classes: I ≤ 1 cm, II > 1 and ≤ 2 cm, III > 2 cm and ≤ 3 cm, and IV > 3 cm and ≤ 4-cm diameter. Changes in size through growth and shrinkage determined the transitions to larger or smaller (respectively) size classes, and the proportion dying by size class provided measures of mortality. Only mortality of the smallest corals (size class I) are analyzed in the present study, as mortality in this size class was higher than the other size classes, and reflects the demographic bottleneck affecting the population size of corals. Corals that grew out of the target size range (i.e., ≤ 4-cm diameter) were excluded from the matrices, but were used to calculate the rate of graduation out of the study size range. Only graduation from size class IV was analyzed, as few corals in the smaller size classes graduated within a year (i.e., they increased to > 4-cm diameter within a year). With this approach, changes in abundance of colonies in the assemblage was caused by both death and graduation from the size range, and the main effect of mortality is individually reported for size class I, which had the highest mortality rate. To gain insight into changes in coral abundance in this size-defined assemblage due to mortality alone, and its contribution to the whole coral community, matrices also were computed with size class IV defined as > 3-cm (i.e., graduates, colonies > 4 cm, were retained).

The NMDS was prepared using Primer software, and the matrices were used to calculate the intrinsic rate of population increase (λ), using the Poptools 2.4 add-in to Excel 2000 operating in a 32 bit, Window environment. λ values were calculated using matrices structured through mortality and graduation, and the effects of graduation versus mortality were explored using λ calculated from matrices incorporating only mortality (i.e., graduating colonies were retained).

To test for associations between vital rates (λ, mortality of size class I, and graduation from size class IV), linear regressions and second order polynomial relationships were fitted to bivariate relationships in which environmental data (mean temperature, thermally extreme weeks, and rainfall) were independent variables. Goodness of fit was evaluated using least squares regression, and statistics were completed using Systat 13.0 operating in a Windows environment. Model selection (quadratic versus linear) was guided using the lowest AIC values with models differing by ~ 2 providing a basis for distinction. To explore the possibility that λ has changed over time with respect to its sensitivity to environmental conditions, least squares regression was used to calculate the slope of λ on thermally extreme weeks and rainfall using consecutive time periods varying in duration from 3 y to 5 y. These periods were selected as a compromise between quantifying meaningful linear relationships with time and exploring whether they varied over 22 years; non-overlapping periods ensured each regression was statistically independent. Changes over the study in these associations were explored by plotting slopes against time, and testing for associations using Pearson correlations.

Data analyzed with Systat 13 and PRIMER 6.

Data Processing Description

BCO-DMO Processing Notes:
- data extracted to .csv from file "Flor L&O Edmunds 2020 (matrix paper).zip/Data in L&O Paper_21_Oct_2020.xlsx", sheet "growth_and_mortality".
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- joined the original table with latitude and longitude positions

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Data Files

File
L_O_mort_growth.csv (Comma Separated Values (.csv), 247.32 KB) MD5:bf9a744b4779440f1fef9bf375bd6dd0 Primary data file for dataset ID 827764

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Related Datasets

IsSupplementedBy

Edmunds, P. J. (2020) **Annual rainfall between Cabritte Horn and White Point on the south shore of St. John, US Virgin Islands, 1996-2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2020-10-28 doi:10.26008/1912/bco-dmo.827806.1 [view at BCO-DMO]

Edmunds, P. J. (2020) **Seawater temperature between Cabritte Horn and White Point on the south shore of St. John, US Virgin Islands, 1996-2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2020-10-28 doi:10.26008/1912/bco-dmo.827812.1 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
Interval	tear long period over which data were recorded	unitless
Site	study site as in Fig. S1	unitless
lat	latitude; north is positive	decimal degrees
lon	longitude; east is positive	decimal degrees
Tag	unique number given to coral	unitless
Genus	taxon assigned to coral	unitless
Start_mm	diameter in mm of coral when initially tagged	millimeters (mm)
Final_mm	diameter in mm of coral 12 months later; or scored as dead ("Dead")	millimeters (mm)

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Project Information

RUI-LTREB Renewal: Three decades of coral reef community dynamics in St. John, USVI: 2014-2019 (RUI-LTREB)

Website: http://coralreefs.csun.edu/

Coverage: USVI

Describing how ecosystems like coral reefs are changing is at the forefront of efforts to evaluate the biological consequences of global climate change and ocean acidification. Coral reefs have become the poster child of these efforts. Amid concern that they could become ecologically extinct within a century, describing what has been lost, what is left, and what is at risk, is of paramount importance. This project exploits an unrivalled legacy of information beginning in 1987 to evaluate the form in which reefs will persist, and the extent to which they will be able to resist further onslaughts of environmental challenges. This long-term project continues a 27-year study of Caribbean coral reefs. The diverse data collected will allow the investigators to determine the roles of local and global disturbances in reef degradation. The data will also reveal the structure and function of reefs in a future with more human disturbances, when corals may no longer dominate tropical reefs.

The broad societal impacts of this project include advancing understanding of an ecosystem that has long been held emblematic of the beauty, diversity, and delicacy of the biological world. Proposed research will expose new generations of undergraduate and graduate students to natural history and the quantitative assessment of the ways in which our planet is changing. This training will lead to a more profound understanding of contemporary ecology at the same time that it promotes excellence in STEM careers and supports technology infrastructure in the United States. Partnerships will be established between universities and high schools to bring university faculty and students in contact with k-12 educators and their students, allow teachers to carry out research in inspiring coral reef locations, and motivate children to pursue STEM careers. Open access to decades of legacy data will stimulate further research and teaching.

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Funding

Funding Source	Award
NSF Division of Environmental Biology (NSF DEB)	DEB-1350146

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